Project Report
VirtualEye - Life Guard for Swimming Pools to Detect Active Drowning

Team ID	**:**	PNT2022TMID50339
Team Leader	**:**	CHINNUPANDI S (952319104008)
Team Member	**:**	RADHA KRISHNAN G (952319104034)
		SRINIVAS K (952319104040)
		SUBRAMANIARAJ R (952319104044)
		VISWA M (952319104053)
College Name	**:**	PSN ENGINEERING COLLEGE
Faculty Mentor	**:**	S.Reny
Industrial Mentor	**:**	Swathi

1.INTRODUCTION

Recently, there has been growing interest around the topic of drowning detection systems (DDS) in the sport and leisure industry both across the UK and globally. Advancements in technology, coupled with the importance of pool safety, has led to its growing prominence, with mention of DDS now in documents such as HSG179 - the latest UK standards document for health and safety in swimming pools (Health and Safety Executive, 2018). However, the topic is a debated area for various reasons explored in this review.Whilst there are plenty of academic articles dedicated to the technology and design behind these products in the fields of biometrics, computer science and electronic engineering, there is limited academic research investigating their application to real-world scenarios. Furthermore, there is uncertainty around their use alongside traditional lifeguarding; whether international testing standards (ISO standards) are robust enough; and general risks affecting the effectiveness of these products. This includes factors such as water clarity, high pool occupancy, lighting, glare and attractions such as water slides and wave machines. These concerns alongside the lack of research and high installation costs have resulted in a reluctance by some operators to incorporate DDS into their pools. This signifies the importance of independent research into DDS. intends to support the move towards the shared goal of improved pool safety.

1.1. Project Overview

Swimming pools are found larger in number in hotels, and weekend tourist spots and barely people have them in their house backyard. Beginners, especially, often feel it difficult to breathe underwater which causes breathing trouble which in turn causes a drowning accident. By studying body movement patterns and connecting cameras to artificial intelligence (AI) systems we can devise an underwater pool safety system that reduces the risk of drowning. Usually, such systems can be developed by installing more than 16 cameras underwater and ceiling and analyzing the video feeds to detect any anomalies.
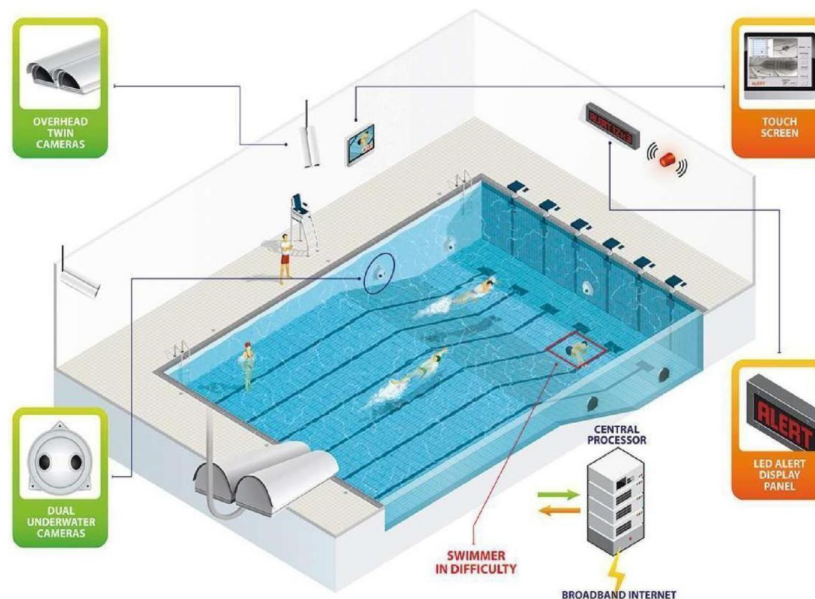
1.2. Purpose

It helps the lifeguard to detect the underwater situation where they can't easily observe.

➢ Establish and outline what is known on Drowning Detection Systems.

➢ Evaluate the current literature on Drowning Detection Systems, including their use in indoor pool environments along with interaction with traditional lifeguarding.

➢ Better understand where DDS are positioned in the health and safety

landscape of indoor swimming pools.

2.LITERATURE SURVEY

2.1. Existing problem

Whilst literature on DDS mostly agrees on areas such as the risks and issues associated with DDS performance, there are other areas where sources offer differing points of view, for example, DDS and their co- existence with lifeguards. There is debate around whether DDS can be helpful or harmful towards lifeguarding practices and how DDS may change the landscape of traditional lifeguarding, as well as some disagreement on whether they serve as justification for reducing lifeguard numbers. The term 'blended lifeguarding' or 'modern lifeguarding' has been newly coined to describe the concept of traditional lifeguarding practices being blended with technology for drowning detection (Swimming Pool Scene, 2017).Currently, there is little qualitative or quantitative research analysing the experiences of lifeguards themselves relating to this concept.

2.2. References

https://www.angeleye.tech/us/us-lifeguard/
https://swimeye.com/
https://www.thewirh.com/blog/dds-how-do-they-work

2.3. Problem Statement Definition

Problem Statements (PS)	I am	I'm trying to	but	Because	Which makes me feel
PS-1	Pool owner	Give high Security	I cann't ensure safety	More likely to drown	Pressure
PS-2	Parents	Get my kids into swimming	I cann't leave him alone to swim	Drowing is more possible	Fear
PS-3	Beginner in swimming	Swim on the pool	It hesitates me a little	I don't know Swimming	Panic
PS-4	Lifeguard	Save the people	I cann't save those people without prior intimation	There is no detection system	Helpless
PS-5	Depressed people	Relax my mind by swimming	I cann't swim on my own	If I accidently drown	Afraid

3.IDEATION & PROPOSED SOLUTION

3.1. Empathy Map Canvas
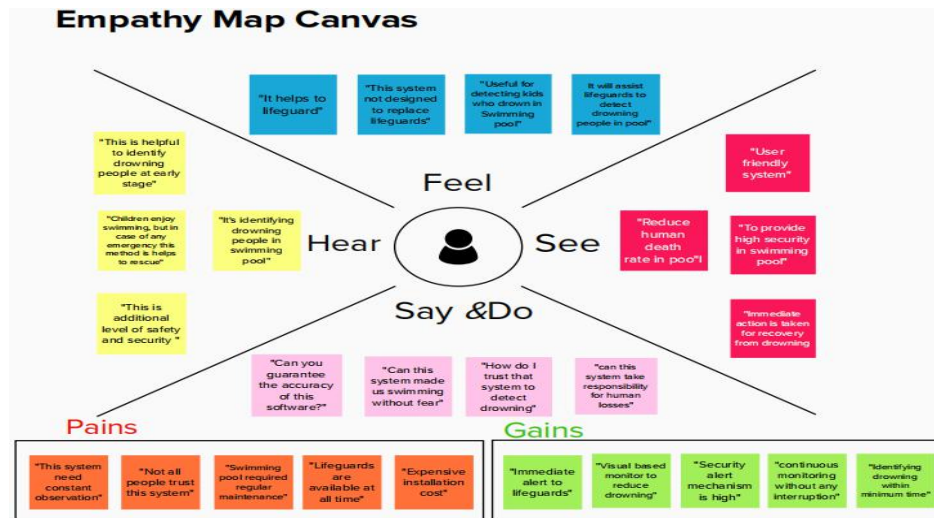
3.2. Ideation & Brainstorming

3.3. Proposed Solution

3.	Novelty / Uniqueness	Virtual eye has developed a novel idea of alerting the ambulance and another life guard if there is any delay in saving the person to death.
4.	Social Impact / Customer Satisfaction	Drowning produces a higher rate of mortality without causing injury to children. Children under six of their age are found to be suffering the highest drowning mortality rates worldwide. Such kinds of deaths account for the third cause of unplanned death globally, with about 1.2 million cases yearly. To overcome this conflict, a meticulous system is to be implemented along the swimming pools to save human life. By studying body movement patterns and connecting cameras to artificial intelligence (AI) systems we can devise an underwater pool safety system that reduces the risk of drowning.
5.	Business Model (Revenue Model)	There are many products currently available in this regard. Our solution, once developed well, has enough possibility to become a good product to save drowning victims.
6.	Scalability of the Solution	Our proposed solution is very scalable i.e., in future,there are a lot of rooms forevolving our present model by Adding new features to enhance our system in the future.

3.4. Problem Solution fit

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) **CS** Children under six	6. CUSTOMER CONSTRAINTS ▬ spending power, budget, no cash, network connection, available devices.	5. AVAILABLE SOLUTIONS ▬ Fire fighters and trained swimmers	Explore AS, different
Focus on J&P, tap into BE, understand RC	2. JOBS-TO-BE-DONE /PROBLEMS ▬ we make use of one camera that streams the video underwater and analyses the position of swimmers to assess the probability of drowning	9. PROBLEM ROOT CAUSE **RC** customers have to do it because of the change in luxurious activities have drastically increased and polls have become common everywhere.	7. BEHAVIOUR **BE** Install drowning detectors, or call for emergency help	Focus on J&P, tap into BE, understand RC
	3. TRIGGERS **TR** Seeing others install virtual eye on their swimming pools	10. YOUR SOLUTION **SL** we make use of one camera that streams the video underwater and analyses the position of swimmers to assess the probability of drowning	8. CHANNELS of BEHAVIOUR **CH** 8.1 ONLINE Ordering of drowning detectors, or pool lifeguards 8.2 OFFLINE	

4. REQUIREMENT ANALYSIS

4.1. Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Installation	Needed to be fixed under the water without creating any disturbance to the people in the swimming pool.
FR-2	Detection	Either horrified or in unconscious
FR-3	Audio	Ask for help or stay quiet if the person is unconscious
FR-4	Support	Take swim tubes or take the help of rescuer
FR-5	Prior Alert	Send alert message to the lifeguard

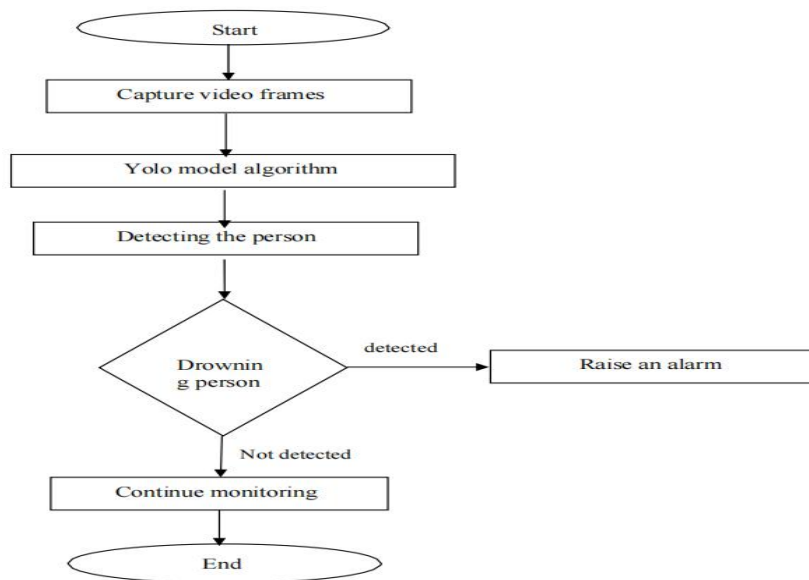## 4.2. Non-Functional requirements

| NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	To ensure the safety of each and every person present in the pool. A Lifeguard should be present all the time in the pool.

NFR-2	Security	Lifeguards should be aware of the alert message to save the life of the swimmer
NFR-3	Reliability	Virtual eye lifeguard triggers an immediate prior alarm if a swimmer is in peril, helping to avoid panic even in critical situations.
NFR-4	Performance	The alarm is triggered when the swimmer's pulse rate is decreasing
NFR-5	Availability	Equipment and accessories include lifesaver rings, inflatable vests, a Shepherd's Crook, life hooks, spine boards, rescue tubes, and a first aid kit. Remember to keep them accessible to quickly pull someone from the water safely.
NFR-6	Scalability	Virtual eye lifeguard detects potential drownings and promptly notifies you. It features the latest artificial intelligence technology and adapts to the needs of the user.

5.PROJECT DESIGN

5.1. Data Flow Diagrams

5.2. Solution & Technical Architecture
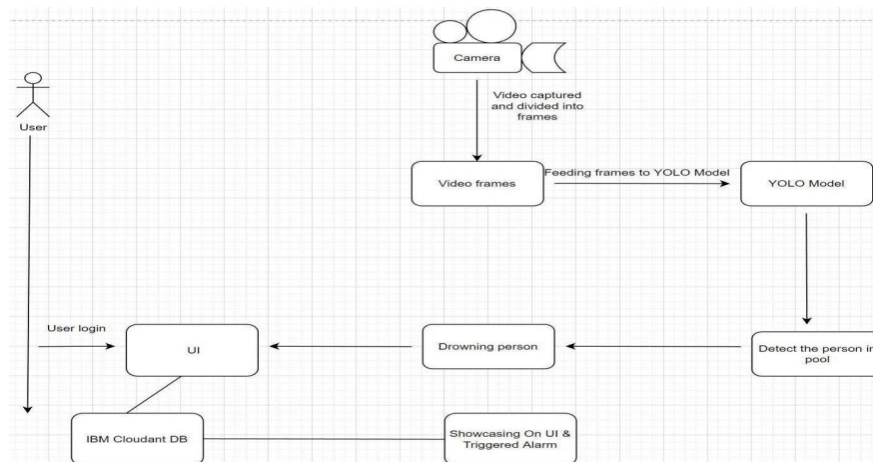
5.3. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Pool owner)	Installation	USN-1	Install the camera inside the underwater, connect necessary app in the phone or other device	I can cameras to the IBM cloudDB	High	Sprint-1
Customer (Lifeguard)	Secure thepeople	USN-2	As a user, I can secure the drowning personsfrom the pool	I can save the drowning person	High	Sprint-1
Customer (swimmers)	safety	USN-3	As a user, I can swim inside the underwater without fear of the Drowning	I can swim safely	medium	Sprint-2
Customer care (Executive)	Contact	USN-4	As a user, I Can resolve if any problem occurswith any device technically	I can contact the customer care executiveto resolve any issues	Medium	Sprint-3
Administrator	Dashboard	USN-5	Management of the drowning detection systemand database management	I can access the system's logs and any other data instantly	High	Sprint-4

6.PROJECT PLANNING & SCHEDULING

## 6.1. Sprint Planning & Estimation

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date(Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date(Actual)
Sprint-1	8	6 Days	25 -10-2022	30-10-2022	5	30-10-2022
Sprint-2	14	6 Days	31-10- 2022	05-11-2022	11	05-11-2022
Sprint-3	16	6 Days	06-11-2022	12-11- 2022	10	12-11-2022
Sprint-4	12	6 Days	14-11-2022	19-11-2022	12	19-11-2022

6.2. Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	VLGFSP-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Chinnupandi S
Sprint-1	Registration	VLGFSP-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Srinivas K
Sprint-1	Registration	VLGFSP -3	As a user, I can register for the application through Facebook	2	Low	Subramaniaraj R
Sprint-1	Registration	VLGFSP -4	As a user, I can register for the application through Gmail	2	Medium	Viswa M
Sprint-1	Login	VLGFSP -6	As a user, I can log into the application by entering email & password	1	High	Radha Krishnan G
Sprint-2	Dataset Collect	VLGFSP -11	Collect number of datasets and get accuracy	2	Medium	Chinnupandi S
Sprint-2	Pre-processing	VLGFSP -12	The dataset is extracted	2	High	Subramaniaraj R
Sprint-2	Train the model	VLGFSP -13	Train the model.	4	High	Srinivas K

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Test the model	VLGFSP -14	Test the model	6	High	Radha Krishnan G
Sprint-3	Detection	VLGFSP -15	Load the trained model.	3	High	Viswa M
Sprint-3	Detection	VLGFSP -16	Identify the person by collecting real-time data through a webcam.	5	Medium	Subramaniaraj R
Sprint-3	Detection	VLGFSP -16	classify it by using a trained model to predict the output	8	High	Chinnupandi S
Sprint-4	Detection	VLGFSP -17	If person is drowning, the system will ring an alarm to give signal	7	High	Srinivas K
Sprint-4	Detection	VLGFSP -18	As a User,I can detect the drowning person.	3	Medium	Radha Krishnan G
Sprint-4	Logout	VLGFSP -19	As a User,I can logout the application.	2	Low	Viswa M

6.3. Reports from JIRA
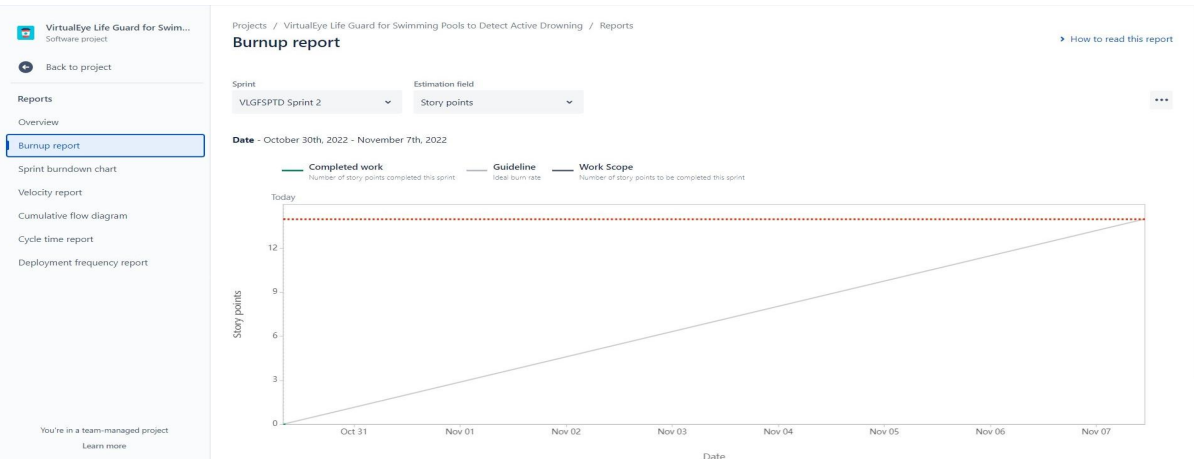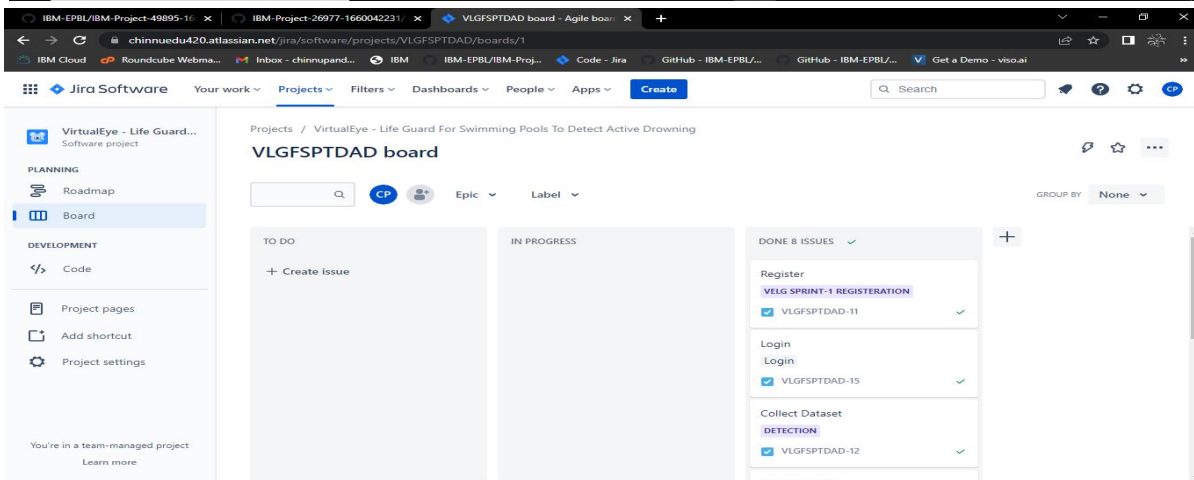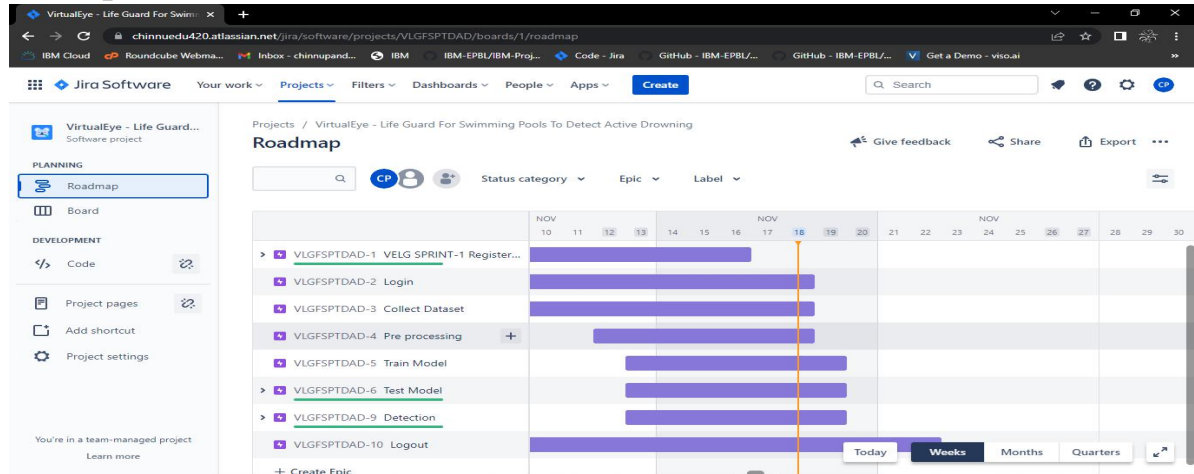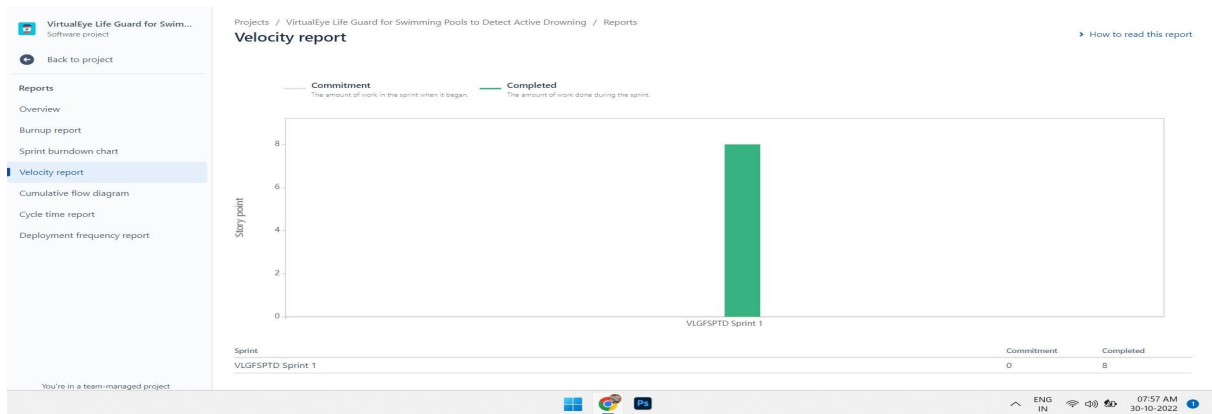
7.CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1. Feature 1

Humans have always had the innate ability to recognize and distinguish between faces. Now computers are able to do the same. This opens up tons of applications.Face detection and recognition is a heavily researched topic and there are tons of resources online. We have tried multiple open source to find the ones that are simplest to implement while being accurate. We have also created a pipeline for detection, recognition and emotion understanding on any input image with just 8 lines of code after the images have been loaded!

7.2. Feature 2

Most strokes involve rhythmic and coordinated movements of all major body parts — torso, arms, legs, hands, feet, and head.

8.TESTING

8.1. Test Cases
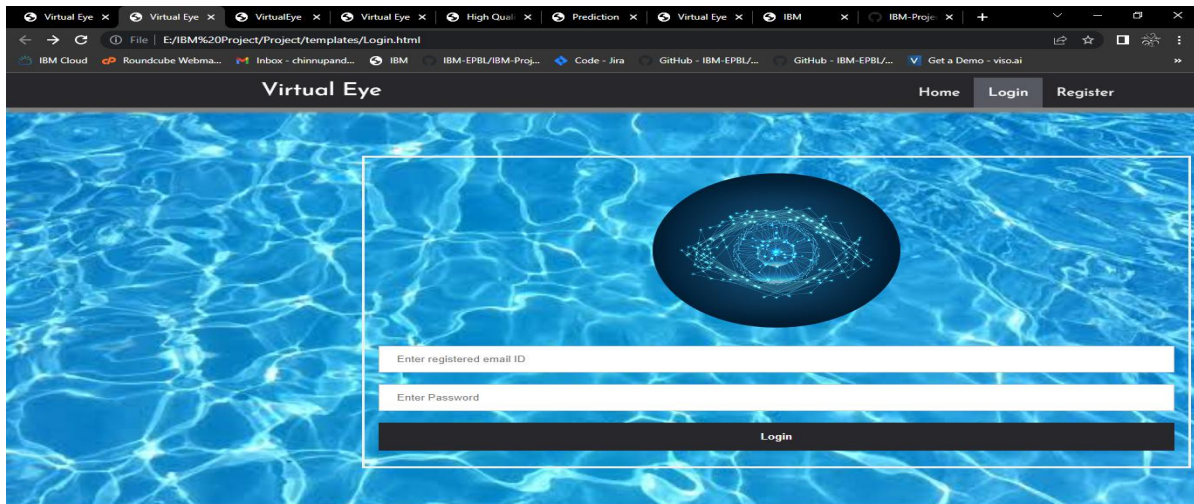
8.2. User Acceptance Testing

1. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	2	0	0	2
Client Application	2	0	0	2
Security	1	0	0	1
Outsource Shipping	1	0	0	1
Exception Reporting	2	0	0	2
Final Report Output	1	0	0	1

2. Test Case Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

This report shows the number of test cases that have passed, failed, and untested

Version Control	1	0	0	1

9.ADVANTAGES & DISADVANTAGES

✓ The Approach detected human drifting and drowning up to a range of 5m in water bodies. The final result achieved an average of 82.10% accuracy.

✓ Identifies drowning victims in a minimum amount of time and dispatches an automated drone to save them

✘ Too much air bubbles generated by the drowning swimmer in the water will also occur. There is a chance that the action cannot be captured by the computer

10. CONCLUSION

The system is not designed to replace a lifeguard or other human monitor, but to act as an additional tool. "It helps the lifeguard to detect the underwater situation where they can't easily observe".

11. APPENDIX

Source Code:

Index.html

```html
<html lang="en">
<head>
 <meta charset="UTF-8" />
 <meta http-equiv="X-UA-Compatible" content="IE=edge" />
 <meta name="viewport" content="width=device-width, initial-scale=1.0" />
 <style>
   * {
 margin: 0;
 padding: 0;
 box-sizing: border-box;
 }
 body {
  font-family: cursive;
 }
 a {
  text-decoration: none;
 }
 li {
  list-style: none;
 }
 .navbar {
  display: flex;
  align-items: center;
  justify-content: space-between;
  padding: 20px;
  background-color: #7ec5fd;
  color: #fff;
 }
 .nav-links a {
  color: #fff;
 }
 /* LOGO */
 .logo {
  font-size: 32px;
 }
 /* NAVBAR MENU */
```

```css
.menu {
 display: flex;
 gap: 1em;
 font-size: 18px;
}
.menu li:hover {
 background-color: #4c9e9e;
 border-radius: 5px;
 transition: 0.3s ease;
}
.menu li {
 padding: 5px 14px;
}
.services {
 position: relative;
}
.dropdown {
 background-color: rgb(1, 139, 139);
 padding: 1em 0;
 position: absolute; /*WITH RESPECT TO PARENT*/
 display: none;
 border-radius: 8px;
 top: 35px;
}
.dropdown li + li {
 margin-top: 10px;
}
.dropdown li {
 padding: 0.5em 1em;
 width: 8em;
 text-align: center;
}
.dropdown li:hover {
 background-color: #4c9e9e;
}
.services:hover .dropdown {
 display: block;
}
#example1 {
  background: url('swimin.jpg');

}
#swim
{
  height: 220px;
 width: 70%;
```

```
        }
      </style>
      <title>VirtualEye</title>
    </head>
    <body>
      <nav class="navbar">


        <div class="logo">VIRTUAL EYE</div>


        <ul class="nav-links">


          <div class="menu">
            <li><a href="/static/.html">Home</a></li>
            <li><a href="/static/.html">About</a></li>
            <li class="services"><a href="/">Services</a></li>
                    <li><a href="/static/register.html">Register</a></li>
                    <li><a href="/static/login.html">Login</a></li>


          </div>
        </ul>
      </nav>
      <form action="index.html" method="post">
                    <div class="">
                            <img style="height:500px; width:1500px"src="E:\IBM Project\Project\static\background.jpg">

                            <a href="/result.html"><button style = "position:absolute; right:60px; bottom:45px; height:40px;
width:500px; color:cyan; background:black;">TRY THIS PROJECT IN DEMO VERSION (CLICK
HERE)</button></a>

                    </div>
      </form>
    </body>
    </html>
```

Prediction.html

```
<html lang="en">
    <head>
            <meta charset="UTF-8">
            <meta http-equiv="X-UA-Compatible" content="IE=edge">
            <meta name="viewport" content="width=device-width, initial- scale=1.0"> <!--Bootstrap -->
            <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/4.0.0/css/boo tstrap.min.css"
integrity="sha384- Gn5384xqQ1aoWXA+058RXPxPg6fy4IWvTNh0E263XmFcJlSAwiGg FAW/dAiS6JXm"
crossorigin="anonymous">
            <script src="https://code.jquery.com/jquery-3.2.1.slim.min.js" integrity="sha384-
KJ3o2DKtIkvYIK3UENzmM7KCkRr/rE9/Qpg6aAZGJwFDMVNA/GpG FF93hXpG5KkN"
crossorigin="anonymous"></script>
            <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js/1.12.9/umd/ popper.min.js" integrity="sha384-
ApNbgh9B+Y1QKtv3Rn7W3mgPxhU9K/ScQsAP7hUibX39j7fakFPsk vXusvfa0b4Q"
crossorigin="anonymous"></script>
            <script src="https://maxcdn.bootstrapcdn.com/bootstrap/4.0.0/js/bootst rap.min.js" integrity="sha384-
JZR6Spejh4U02d8jOt6vLEHfe/JQGiRRSQQxSfFWpi1MquVdAyjUar5 +76PVCmYl"
crossorigin="anonymous"></script>
            <script src="https://kit.fontawesome.com/8b9cdc2059.js" crossorigin="anonymous"></script>
```

```html
            <link href="https://fonts.googleapis.com/css2?family=Akronim&family= Roboto&display=swap" rel="stylesheet">
            <link rel="stylesheet" href="../static/style.css">
            <script defer src="../static/js/JScript.js"></script>
            <title>Prediction</title>
    </head>
<body>
    <header id="head" class="header">
            <section id="navbar"> <h1 class="nav-heading"></i>Virtual Eye</h1>
            <div class="nav--items">
                    <ul><li><a href="{{ url_for('index')}}">Home</a></li>
                            <li><a href="{{ url_for('logout')}}">Logout</a></li> <!-- <li><a href="#about">About</a></li>
    <li><a href="#services">Services</a></li> -->
                    </ul>
            </div>
            </section>
    </header> <!-- dataset/Training/metal/metal326.jpg --> </br>
    <section id="prediction"> <h2 class="title text-muted">Virtual Eye- Life Guard for Swimming Pools to Detect Active
    Drowning</h1>
            <div class="line" style="width: 900px;"></div>
    </section> </br>
    <section id="about">
            <div class="body">
                    <div class="left">
                            <p>Swimming is one of the best exercises that helps people to reduce stress in this urban lifestyle.
    Swimming pools are found larger in number in the hotels, weekend tourist spots and
                            barely people have in their house backyard. Beginners, especially often feel it difficult to breathe under
    water and causes breathing trouble which in turn cause a drowning accident. Worldwide, drowning
                            produces a higher rate of mortality without causing injury to children. Children under six of their age are
    found to be suffering the highest drowning mortality rates worldwide..Such kinds of deaths account
                            for the third cause of unplanned death globally, with about 1.2 million cases yearly.
                            </p>
                    </div>
            <center>
                    <div class="center">
                            <div class="prediction-input"> <img class="d-block w-100" src="../static/img/second.jpg"
    alt="Second slide"> </br>
                                    <form id="form" action="/result" method="post" enctype="multipart/form-data">
                                            <input type="submit" class="submitbtn" value="Click Me! For a Demo">
                                    </form>
                            </div>
                            <style color="red"><h5>{prediction}</h5> </style>
                    </div>
            </center>
            </div>
    </section> </br></br>
    <section id="footer"> <p>Copyright Â© 2021. All Rights Reserved</p> </section>
</body>
</html>
```

register.html

```html
<html>
<head>
        <meta charset="UTF-8">
        <meta name="viewport" content="width=device-width, initial- scale=1">
        <title>Virtual Eye</title>
        <link href='https://fonts.googleapis.com/css?family=Pacifico' rel='stylesheet' type='text/css'>
        <link href='https://fonts.googleapis.com/css?family=Arimo' rel='stylesheet' type='text/css'>
        <link href='https://fonts.googleapis.com/css?family=Hind:300' rel='stylesheet' type='text/css'>
        <link href='https://fonts.googleapis.com/css?family=Open+Sans+Conde nsed:300' rel='stylesheet' type='text/css'>
        <link href="{{ url_for('static', filename='css/style.css') }}" rel='stylesheet'>
        <link href='https://fonts.googleapis.com/css?family=Merriweather' rel='stylesheet'>
        <link href='https://fonts.googleapis.com/css?family=Josefin Sans' rel='stylesheet'>
        <link href='https://fonts.googleapis.com/css?family=Montserrat' rel='stylesheet'>
        <style>

                .header {
                        top:0;
                        margin:0px;
                        left: 0px;
                        right: 0px;
                        position: fixed;
                        background-color: #28272c;
                        color: white;
                        box-shadow: 0px 8px 4px grey;
                        overflow: hidden;
                        padding-left:20px;
                        font-family: 'Josefin Sans';
                        font-size: 2vw;
                        width: 100%;
                        height:8%;
                        text-align: center;
                                }
                .topnav {
                        overflow: hidden;
                        background-color: #333;
                                }
                .topnav-right a {
                        float: left;
                        color: #f2f2f2;
                        text-align: center;
                        padding: 14px 16px;
                        text-decoration: none;
                        font-size: 18px;
                                }
```

```css
.topnav-right a:hover { background-color: #ddd; color: black; }
.topnav-right a.active { background-color: #565961; color: white; }
.topnav-right { float: right; padding-right:100px; }
.login{ margin-top:-70px; }
body {
        background-color:#ffffff;
        background-repeat: no-repeat;
        background-size:cover;
        background-position: 200px 200px;


        }
body{
                background-image: url('E:\images.jpeg');
                background-position: 0px 0px;}
.login{margin-top:100px; }
form {
        border: 3px solid #f1f1f1;
        margin-right:200px;
        margin- right:200px;
        }
input[type=text], input[type=email],input[type=number],input[type=password] {
        width: 100%;
        padding: 12px 20px;
        display: inline-block;
        margin-bottom:18px;
        border: 1px solid #ccc;
        box-sizing: border-box;
                }
button {
        background-color: #28272c;
        color: white;
        padding: 14px 20px;
        margin-bottom:8px;
        border: none;
        cursor: pointer;
        width: 100%;
        }
button:hover {    opacity: 0.8;      }
.cancelbtn { width: auto; padding: 10px 18px; background-color: #f44336; }
.imgcontainer { text-align: center; margin: 24px 0 12px 0; }
img.avatar { width: 30%; border-radius: 50%; }
.container { padding: 16px; }
span.psw { float: right; padding-top: 16px; }/* Change styles for span and cancel button on extra small
screens */
@media screen and (max-width: 300px) {
                                                span.psw {        display: block;float: none; }
```

```
                                        .cancelbtn { width: 100%; }
                                }
                </style>
        </head>

        <body style="font-family:Montserrat;">

                <div class="header">
                        <div style="width:50%;float:left;font-size:2vw;text- align:left;color:white; padding-top:1%">Virtual
Eye</div>
                        <div class="topnav-right" >
                                <a href="{{ url_for('home')}}">Home</a>
                                <a href="{{ url_for('login')}}">Login</a>
                                <a class="active" href="{{ url_for('register')}}">Register</a>
                        </div>
                </div>
                <div id="login" class="login">
                        <center>
                        <form action="{{url_for('afterreg')}}" method="post">
                                <div class="imgcontainer">
                                        <img style="" src="E:\Virtual Eye.jpg" alt="Avatar" class="avatar">
                                </div>
                                <div class="container">
                                        <input type="text" placeholder="Enter Name" name="name" required><br>
                                        <input type="email" placeholder="Enter Email ID" name="_id" required><br>
                                        <input type="password" placeholder="Enter Password" name="psw" required>
                                        <button type="submit">Register</button><br>
                                </div>
                                <div class="container" style="background- color:#f1f1f1">
                                        <div class="psw">
                                        Already have an account?   
                                        <a href="{{ url_for('login') }}">Login</a>
                                        </div >
                                </div>
                        </form>
                        </center>
                </div>
        </body>
</html>
```

GitHub & Project Demo Link

GitHub Link : https://github.com/IBM-EPBL/IBM-Project-49895-1660882701